Winfield Locks
Failed Embedded Miter Gate Anchorage

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US Army Corps of Engineers
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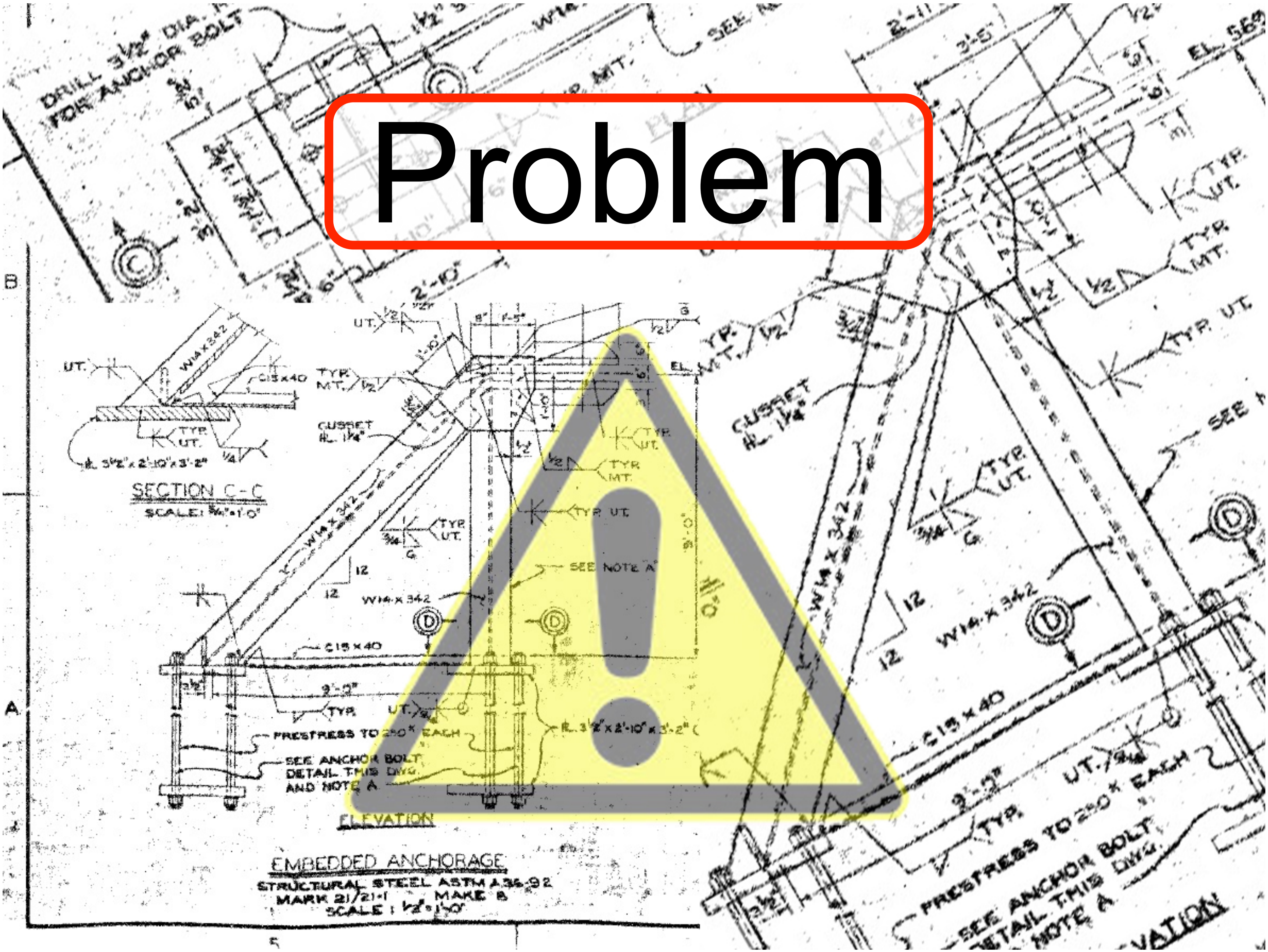
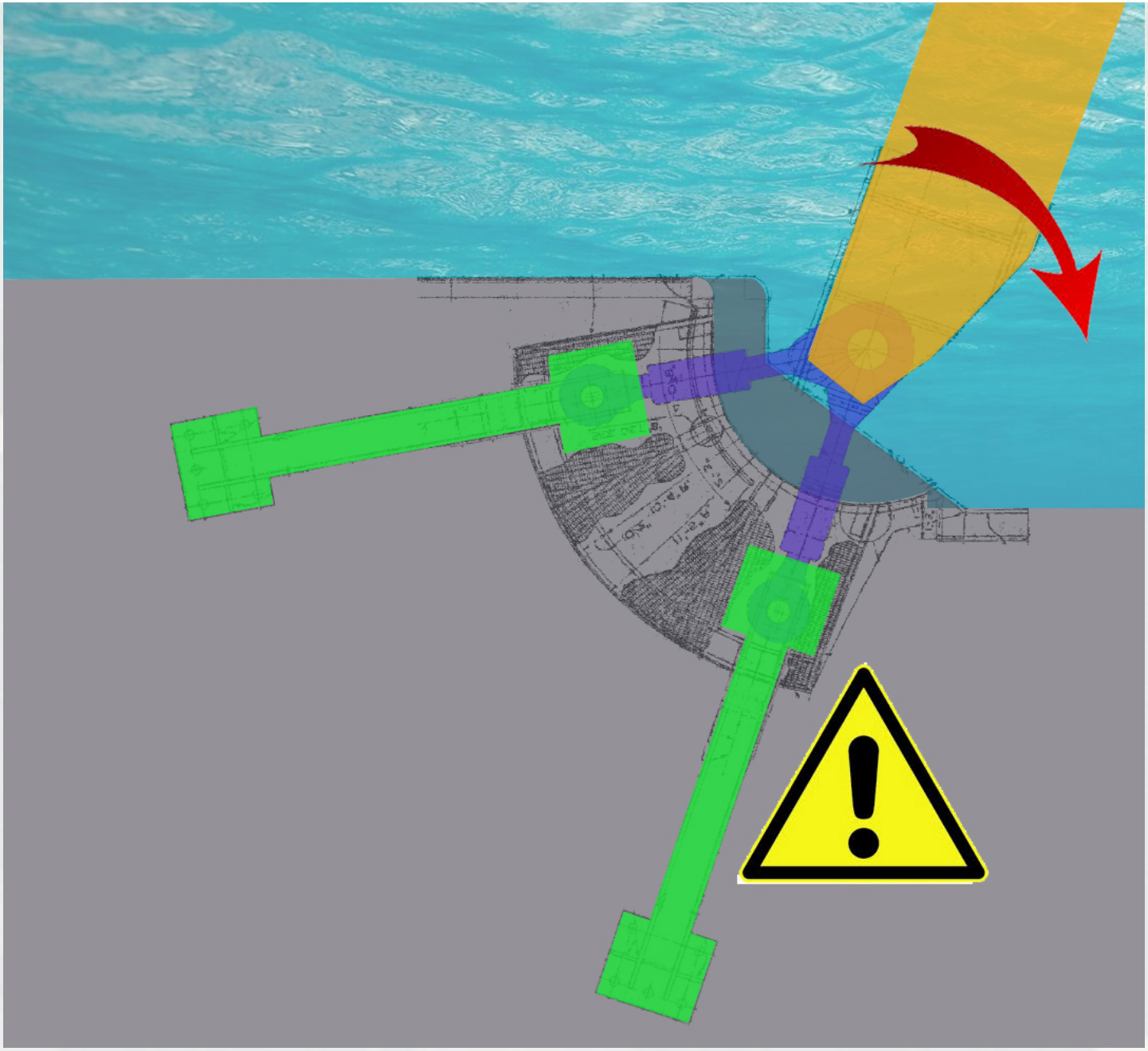
Discussion Points

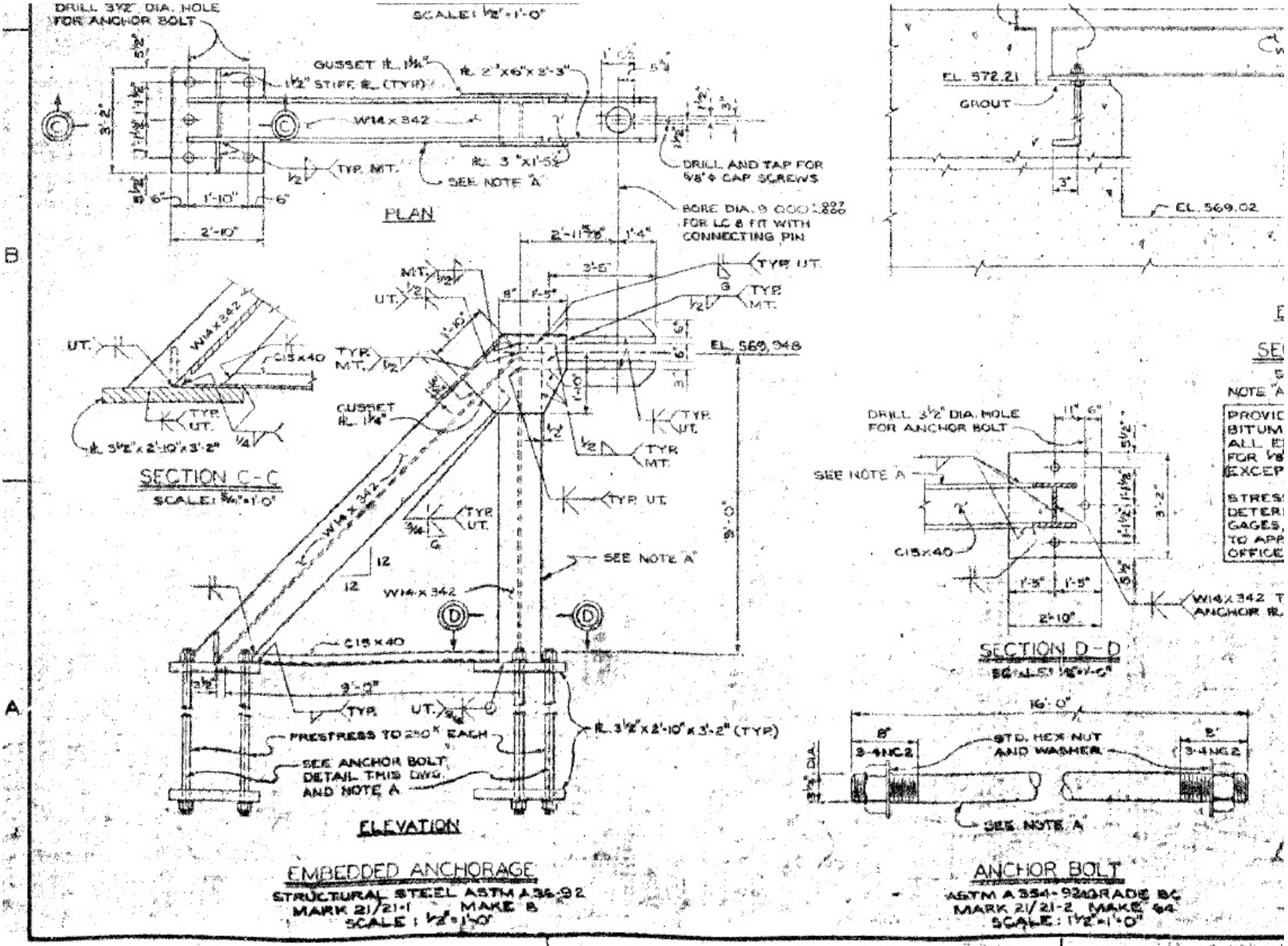
- Problem
- History
- Solution
- Construction
- Results

Problem

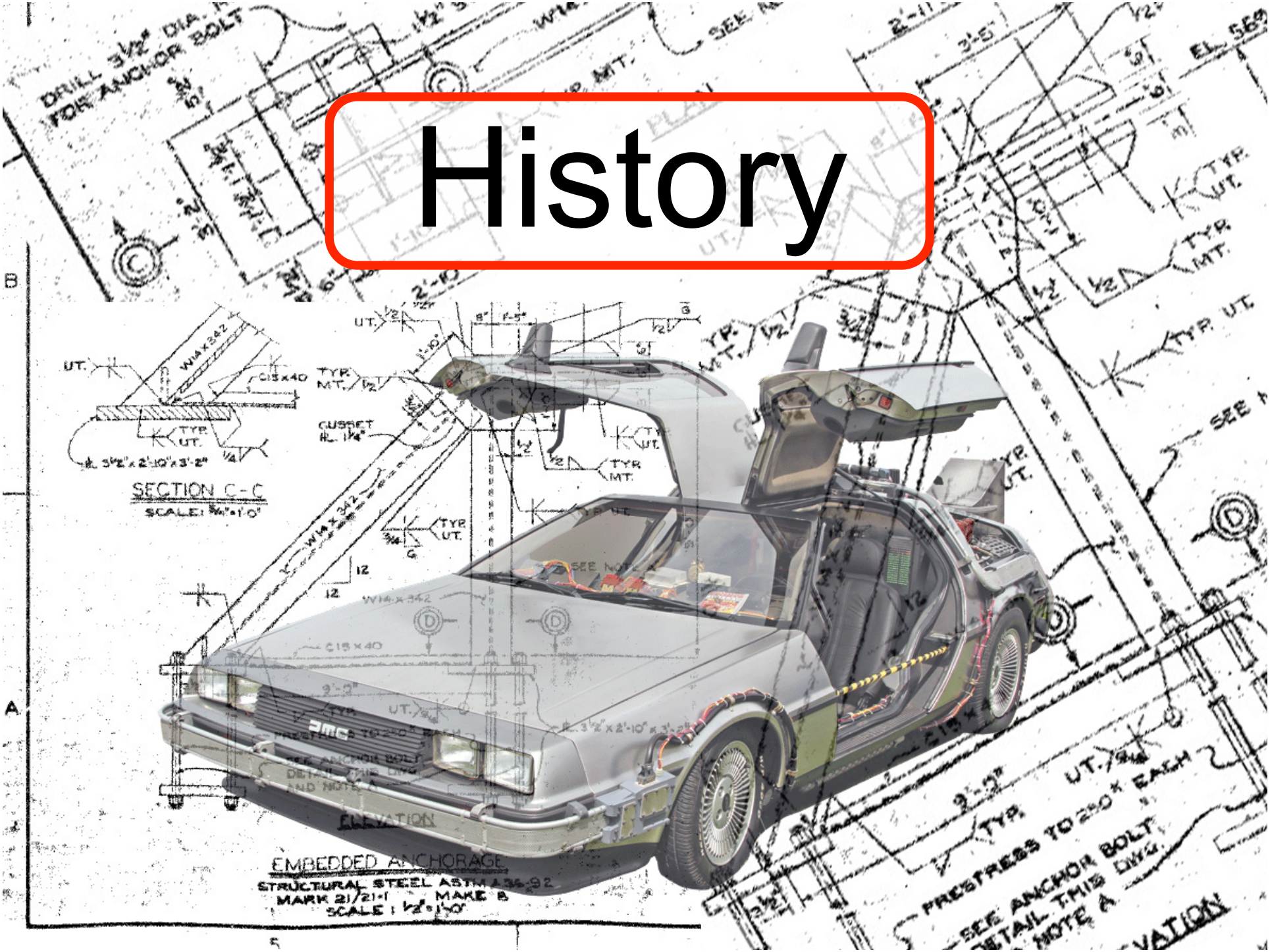

SECTION C-C
ELEVATION
EMBEDDED ANCHORAGE
STRUCTURAL STEEL ASTM A36-92
PRESTRESS TO 250^K EACH
SEE ANCHOR BOLT DETAIL THIS DWG. AND NOTE A
W14 x 342
C15 x 40
GUSSET
TYP. UT.
TYP. MT.
SEE NOTE "A"
DRILL 3 1/2" DIA. FOR ANCHOR BOLT



BUILDING STRONG®


DRILL 3½" DIA. HOLE FOR ANCHOR BOLT
SCALE: ½"=1'-0"
GUSSET PL. 1¼"
PL. 2"X6"X2'-3"
1½" STIFF PL. (TYP.)
W14 x 342
TYP. MT.
PL. 3"X1'-5½"
SEE NOTE 'A'
DRILL AND TAP FOR ⅝"ϕ CAP SCREWS
BORE DIA. 9.000 +.027 -.000 FOR LC 8 FIT WITH CONNECTING PIN
PLAN
EL. 572.21
GROUT
EL. 569.02
TYP. UT.
TYP. MT.
EL. 569.348
C15x40
PL. 3½"x2'-10"x3'-2"
SECTION C-C
SCALE: ¾"=1'-0"
GUSSET PL. 1¼"
SEE NOTE 'A'
PRESTRESS TO 250K EACH
SEE ANCHOR BOLT DETAIL THIS DWG. AND NOTE A
PL. 3½"x2'-10"x3'-2" (TYP.)
ELEVATION
DRILL 3½" DIA. HOLE FOR ANCHOR BOLT
SEE NOTE A
C15x40
W14x342 T ANCHOR PL.
SECTION D-D
SCALE: ½"=1'-0"
16'-0"
8"
3-4 NC 2
STD. HEX NUT AND WASHER
3-4 NC 2
SEE NOTE A
EMBEDDED ANCHORAGE
STRUCTURAL STEEL ASTM A36-92
MARK 21/21-1 MAKE 8
SCALE: ½"=1'-0"
ANCHOR BOLT
ASTM A354-92a GRADE BC
MARK 21/21-2 MAKE 64
SCALE: 1½"=1'-0"

History

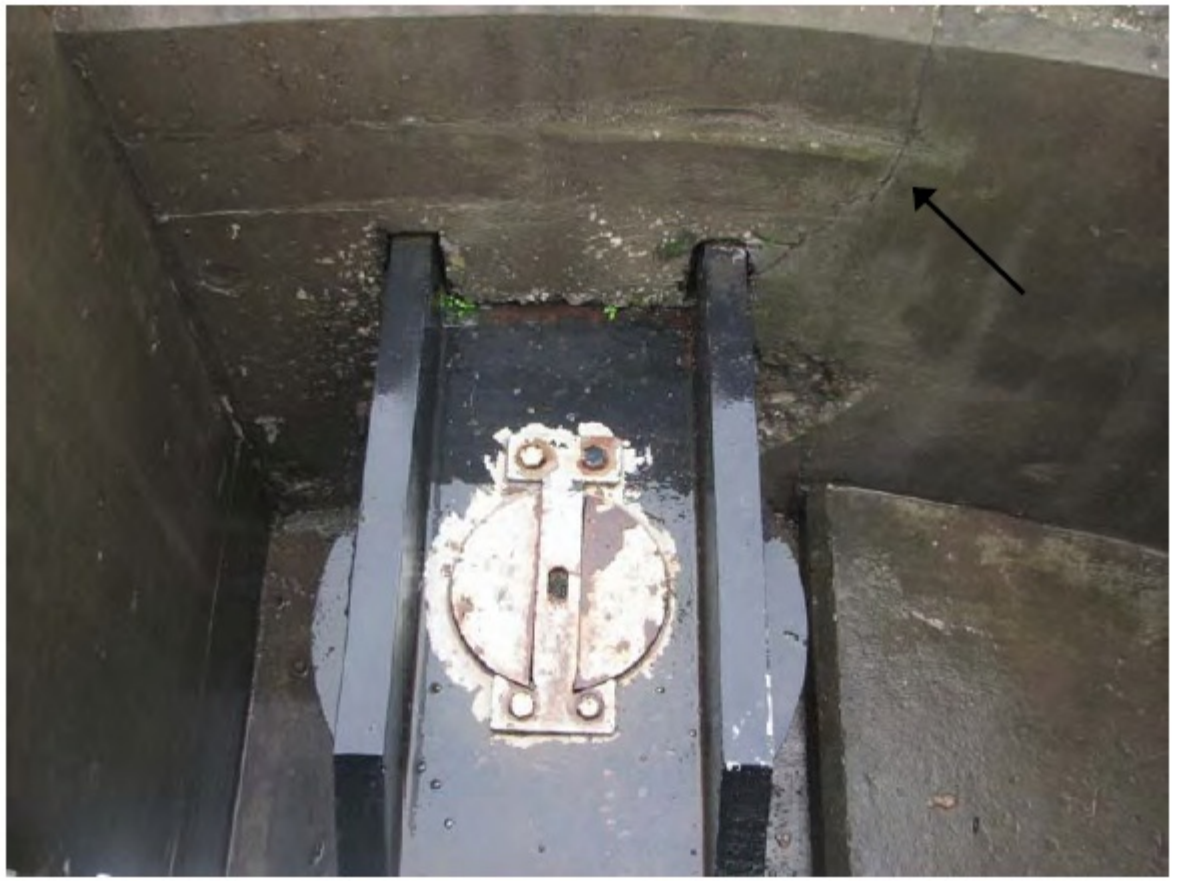

SECTION C-C
SCALE: 3/4"=1'-0"
ELEVATION
EMBEDDED ANCHORAGE
STRUCTURAL STEEL ASTM A36-92
MARK 21/21-1 MAKE 8
SCALE: 1/2"=1'-0"
PRESTRESS TO 250 K EACH
SEE ANCHOR BOLT DETAIL THIS DWG. AND NOTE A

History

- 1995 – Project construction

History

- 2010 – Last Periodic Inspection



Winfield Locks and Dam 19 May, 2010
Photo 222 – Upstream River Wall Miter Gate Anchorage. Crack noted in concrete is typical at all anchorages.

History

- 2010 – Last Periodic Inspection

WINFIELD LOCKS AND DAM
NINTH PERIODIC INSPECTION

KANAWHA RIVER, WV
18 -21 MAY 2010

SUMMARY OF INSPECTION FINDINGS

Cat. No.	Project Feature	Findings / Action Items
2	Original Lock River Wall Turbine Pit	Significant leakage through what is assumed the bulkhead was observed. Bulkhead was unable to be inspected and it is recommended to use ROV to inspect the condition of the bulkhead. Loss of the bulkhead could lead to uncontrollable release of water but not loss of navigation pool. Suggest designing new bulkhead to be installed on the outside face of inlet. Photo 223
4	New Lock Upper Guard Wall	Box beams were in good condition and were dry. Photo 233
4	New Lock Miter Gate Anchorages	Upstream river wall miter gate anchorage exhibits more than anticipated movement during swinging of gate.
		Wall quoins show minor leakage but miter ends show no

History

- 2013 – Movement of Embedded Anchorage noted in annual assessment by project engineer.

MAINTENANCE ASSESSMENT Pg 1/5

PROJECT: Winfield **DATE:** 9/27/2013

RANKINGS
A-As new condition B-Minimal Wear no concern for failure C-Moderate Wear/some concern of failure
D-Excessive Wear/Serious concern of failure F-FAILURE

	Old Chamber 56' x 360'								New Chamber 110' x 800'			
Miter Gate	**Auxiliary "A" Chamber**				**Auxiliary "B" Chamber**				**Main Chamber**			
	Lower Gate		**Upper Gate**		**Lower Gate**		**Upper Gate**		**Lower Gate**		**Upper Gate**	
Components	**RW**	**MW**	**RW**	**MW**	**MW**	**LW**	**MW**	**LW**	**RW**	**LW**	**RW**	**LW**
Hydraulic Cylinder	B	B	B	B	B	B	B	B	A	A	B	B
hpu	B	B	C*	C	B	C*	B	B	B	B	B	B
Controls												
Cross Pin at Gate/Clevis												
Gudgeon Pin												
Quoin Block (visi above water line)												
Top Anchorage components												
Miter Blocks												
Self Miter Device												
Miter Interlock												
Fender Tubes												
Paint Condition												
Diagonal Protecti												
Gate Latching Devices												
Pintle taking Grease?												

COMMENTS:

* Hydraulic oil needs changed in Upper River Wall HPU on Old Chamber and Lower Land. Larger Drip Pans are also required.
** One section of Diagonal Protection damaged by tow several years back.
***HPU would not start.
**** Crosshead pin moves when gate is in motion.
Pintle not receiving grease on all gates on Old Chambers.
Old Chamber: Lower River & Middle Wall Anchorage on River Chamber need replaced
Old Chamber: Also Upper Land and Middle Wall Anchorage on Land Chamber.
3/8" movement in Lower Middle Wall Anchorage (River Chamber)
Old Chamber Replace Pressure Gauges on all HPU's
Old Land Chamber Upper Land Miter Gate: Gate raises up at tow and heel when entering recess.
Gate was not operated due debris buildup on the upstream side.
Bottom seal on Upper Gates of the Old Land Chamber show two "boils" on middle wall gate.
One near the tow and one about midpoint of the gate.
Area to Hyd Cylinders need latched with chain. (open Pits)
LM Bracket for Stop Block missing from gate.
LR no stop block
Old Chamber - only one working tow haulage unit. LM unsure if it will work long due to bearing noises.
New Chamber Hyd Gimbel was moving side to side. Project welded in temp angle and is having Al Shims waterjetted to replace it.
See photos*
New Top Anchorage components installed Feb - Mar 2012 in New Chamber.
New Chamber - movement of embeded anchorage noted when gate is opening and closing.
Project is seeing excessive leaking and wear on proportional valves. Would like to replace with Manifold block
(Currently under Contract)

History

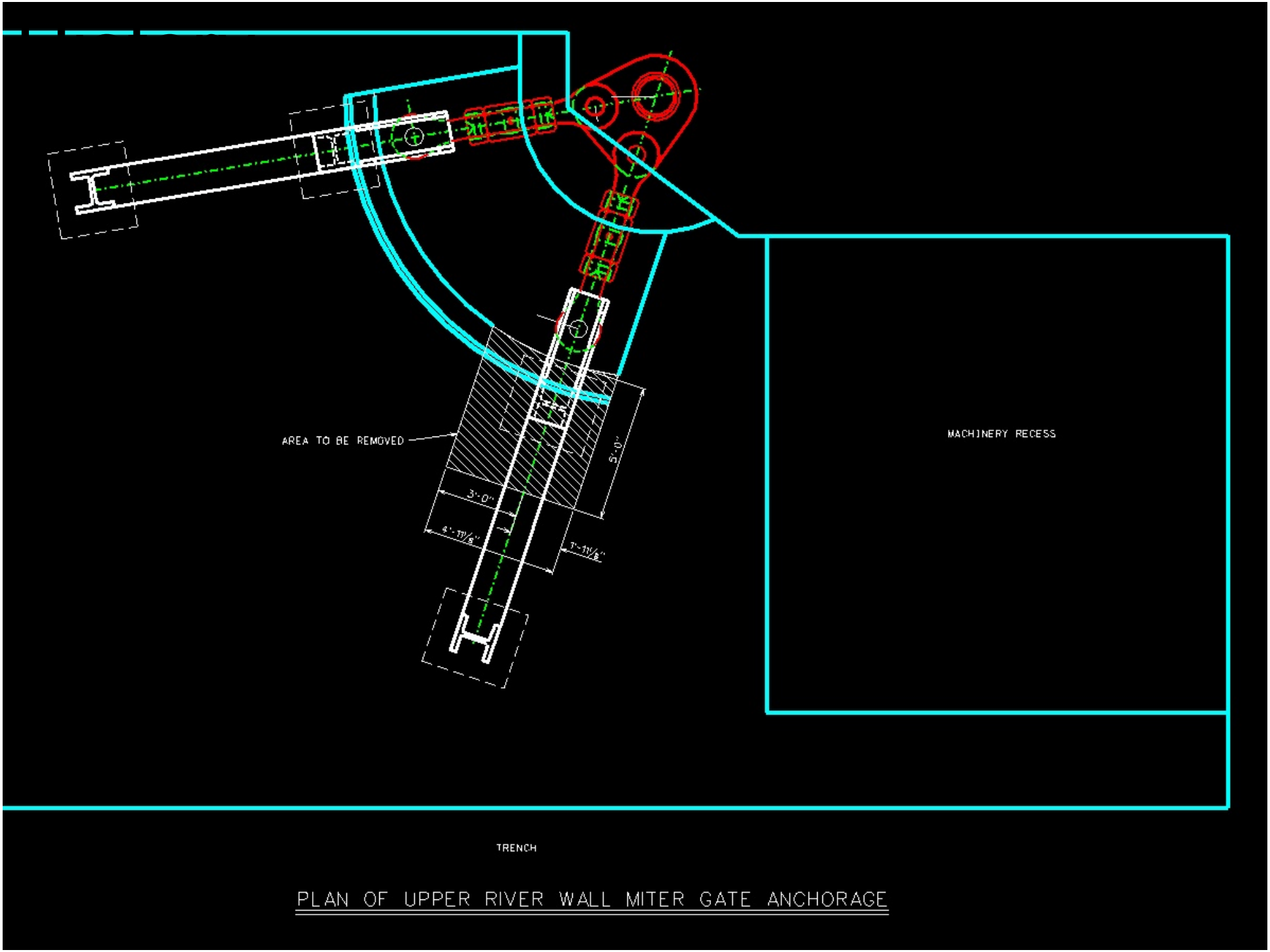
- May 2014 – USRW miter gate cylinder packing failed and during the repair the anchorage was noticed to move more than it had ever in the past
- According to the lockmaster the movement had been around 1/2” for years but during this time it was measured at closer to 1”

History

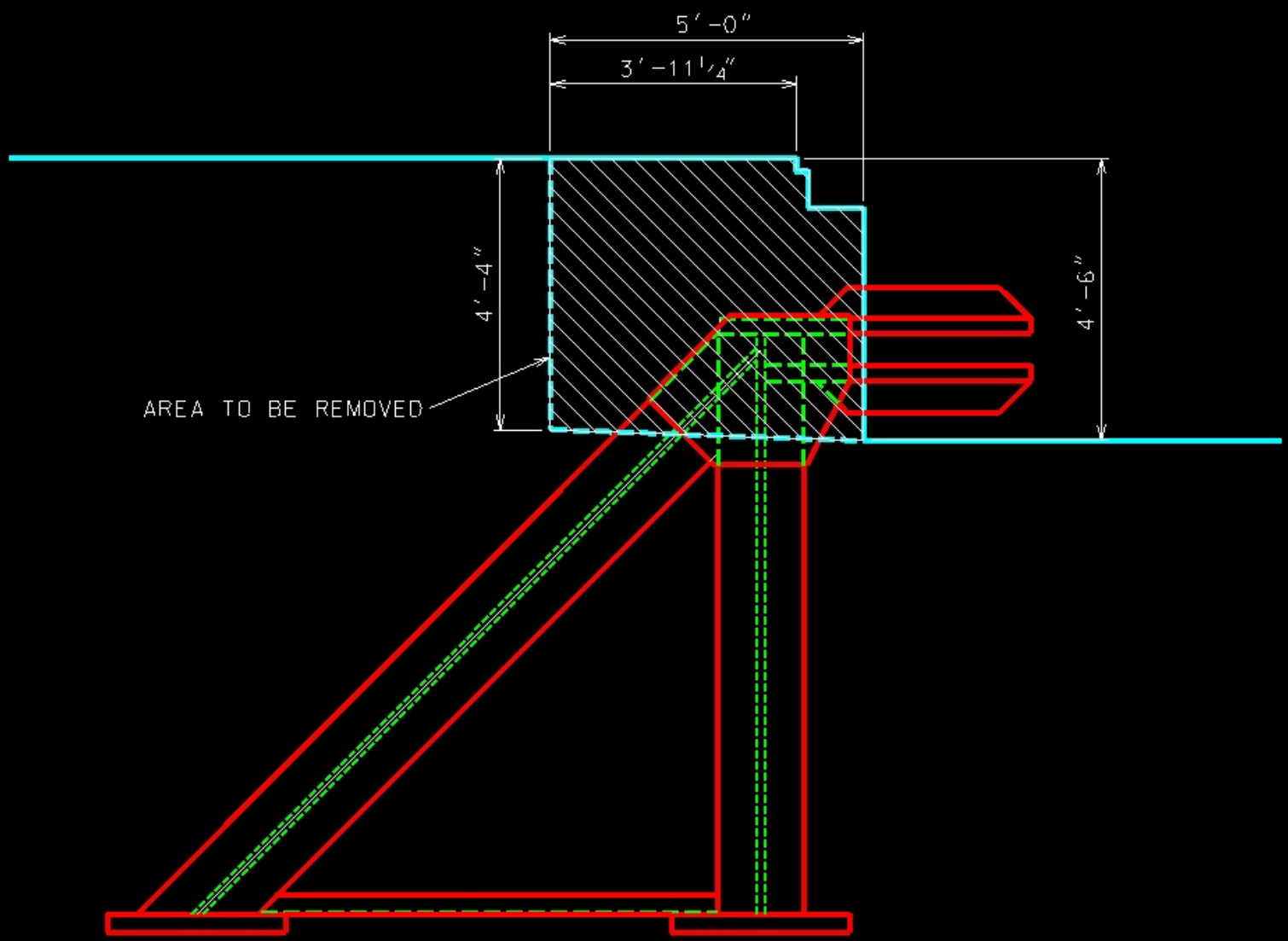
- Project engineers took strain gauge readings of the following. We are interested in seeing the readings after construction is complete.
  - Gate fully in recess and pressure on cylinder: 825 x 10^{-6} kips
  - Gate in recess and pressure released from cylinder: 720 x 10^{-6} kips
  - Initial spike when pushing out of recess: 1200 x 10^{-6} kips
  - Readings through swing from recess to miter: Fluctuates between 900-1200 x 10^{-6} kips
  - Gate in miter position, no head differential, valves 100% open: 1250 x 10^{-6} kips
  - Gate in miter position, full head differential: 1055 x 10^{-6} kips
- At this point the anchorage is taking the majority of the load when the gate is in the miter position.

History

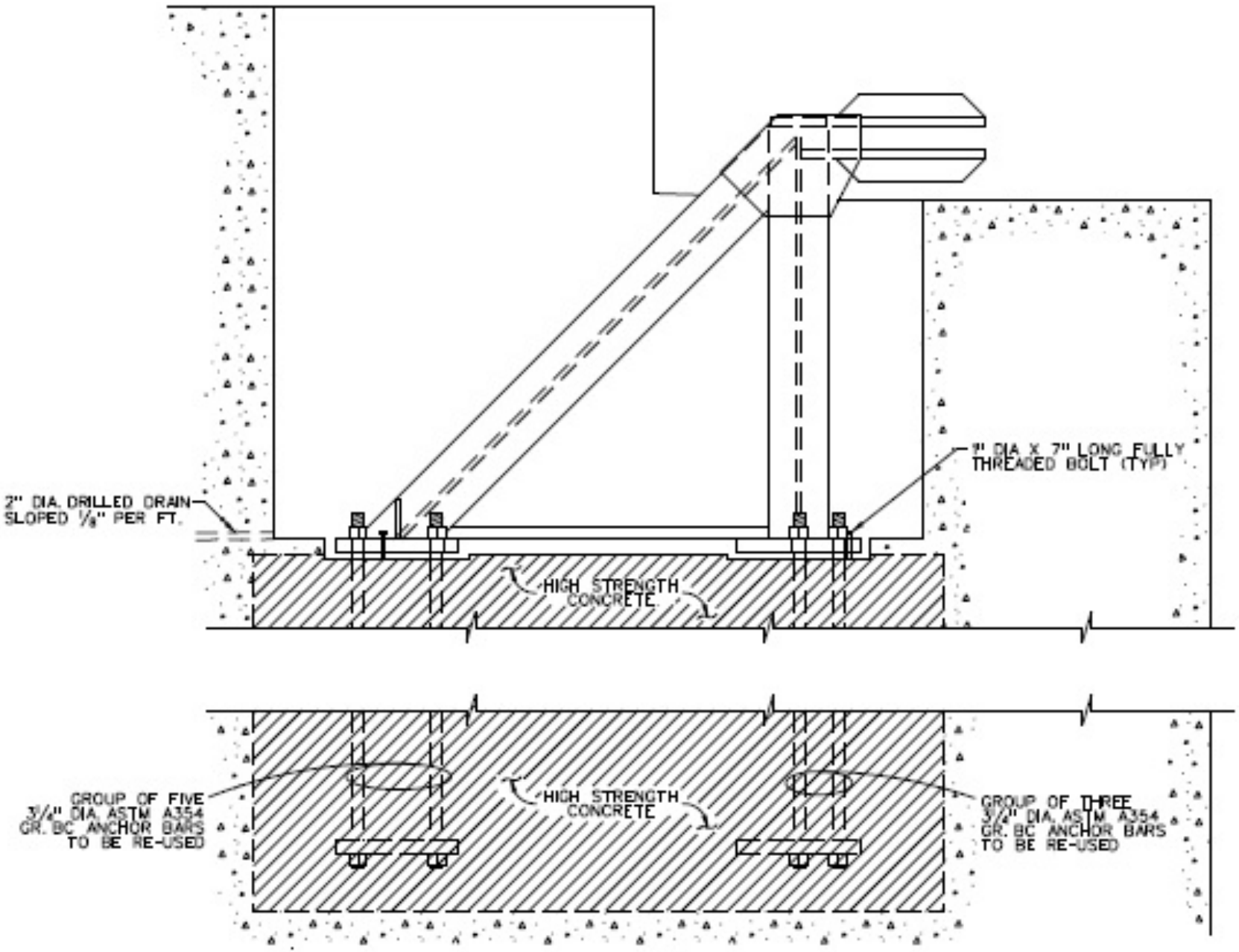
- May 2014 LRL fleet crew removed concrete to expose the top of the embedded anchorage.



PLAN OF UPPER RIVER WALL MITER GATE ANCHORAGE



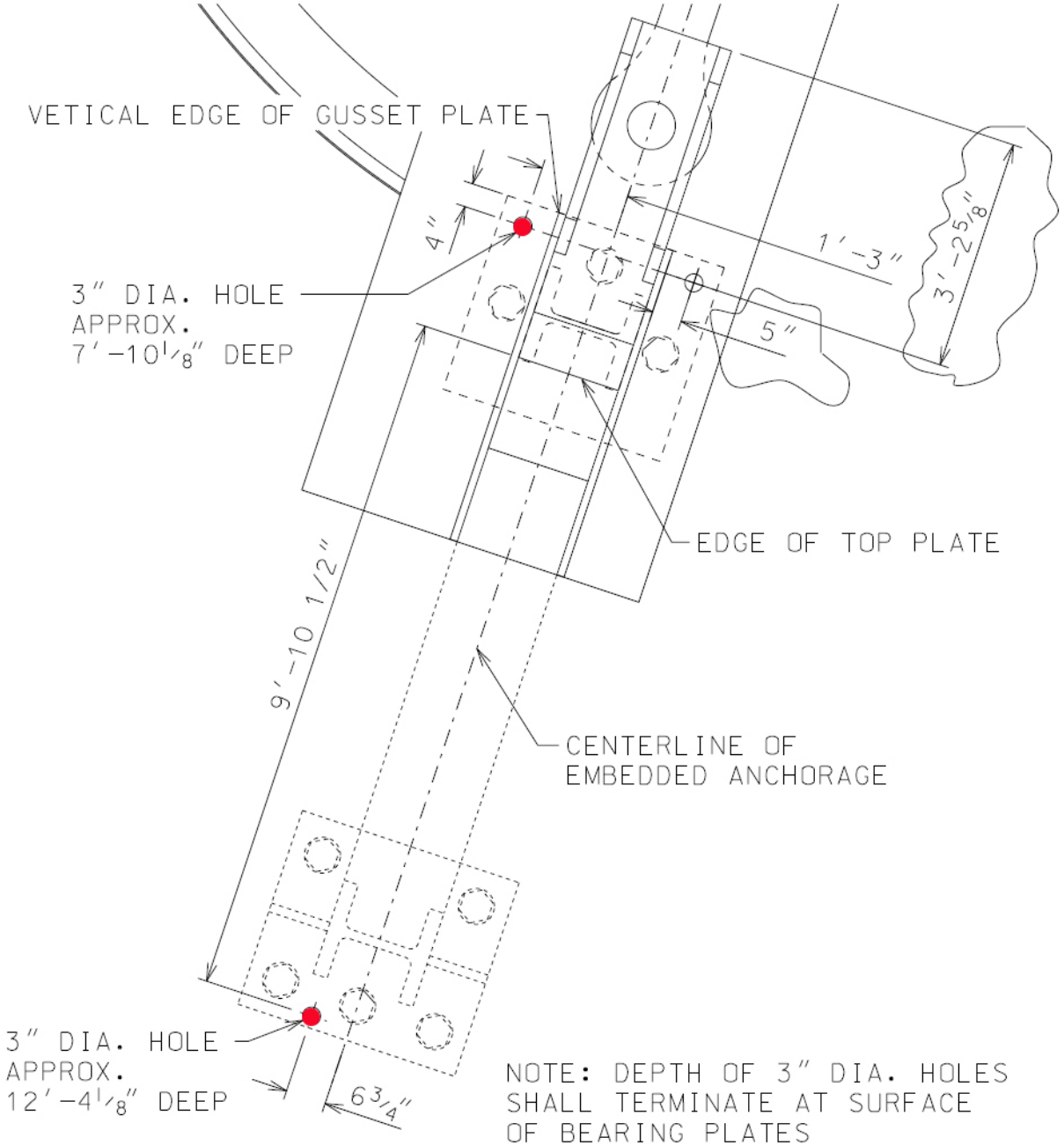
SECTION AT CENTERLINE OF ANCHORAGE



A / S-702 SECTION
SCALE: A

History

- June 2014 – a contractor drilled holes vertically through the lock wall to the anchorage base to measure movement on front and rear of the embedded anchorage


VETICAL EDGE OF GUSSET PLATE
4″
3″ DIA. HOLE
APPROX.
7′–10 1/8″ DEEP
1′–3″
3′–2 5/8″
5″
EDGE OF TOP PLATE
9′–10 1/2″
CENTERLINE OF
EMBEDDED ANCHORAGE
3″ DIA. HOLE
APPROX.
12′–4 1/8″ DEEP
6 3/4″
NOTE: DEPTH OF 3″ DIA. HOLES
SHALL TERMINATE AT SURFACE
OF BEARING PLATES


Winfield
Locks & Dam
LIFE RING

BUILDING STRONG®

Dial Indicator


Front of Anchorage movement was minimal- less than 1/16”


Rear of
Anchorage
movement was
significant-
almost exactly 1”

Solution

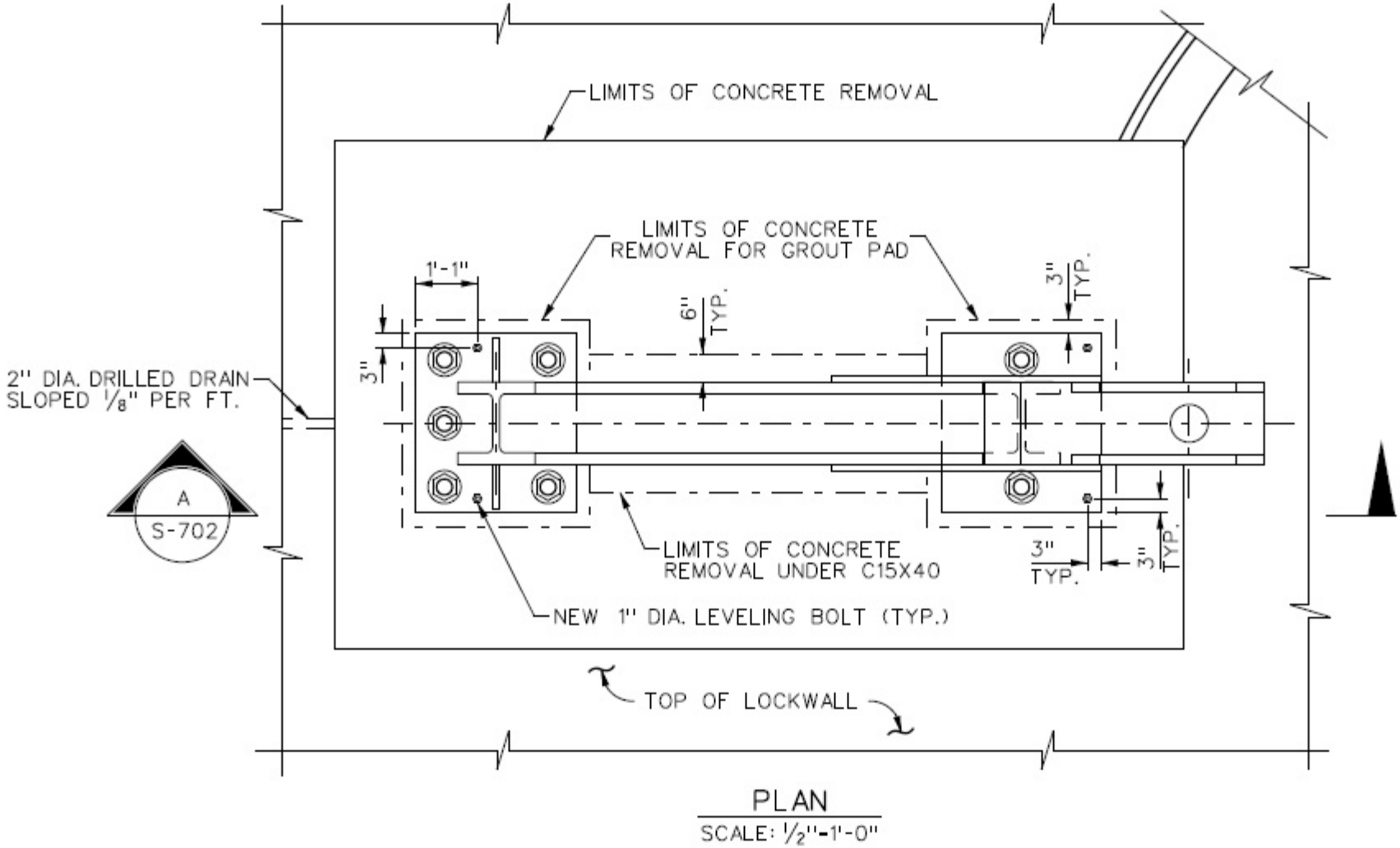
Solution

- June – Aug 2014 - Engineering developed a plan to fix the anchorage.
  - This 3 month window included Engineering's ISO process of internal reviews and preparation of the IGE and Contracting's process to initiate the solicitation process.
  - An IDIQ contract was chosen for quicker response.

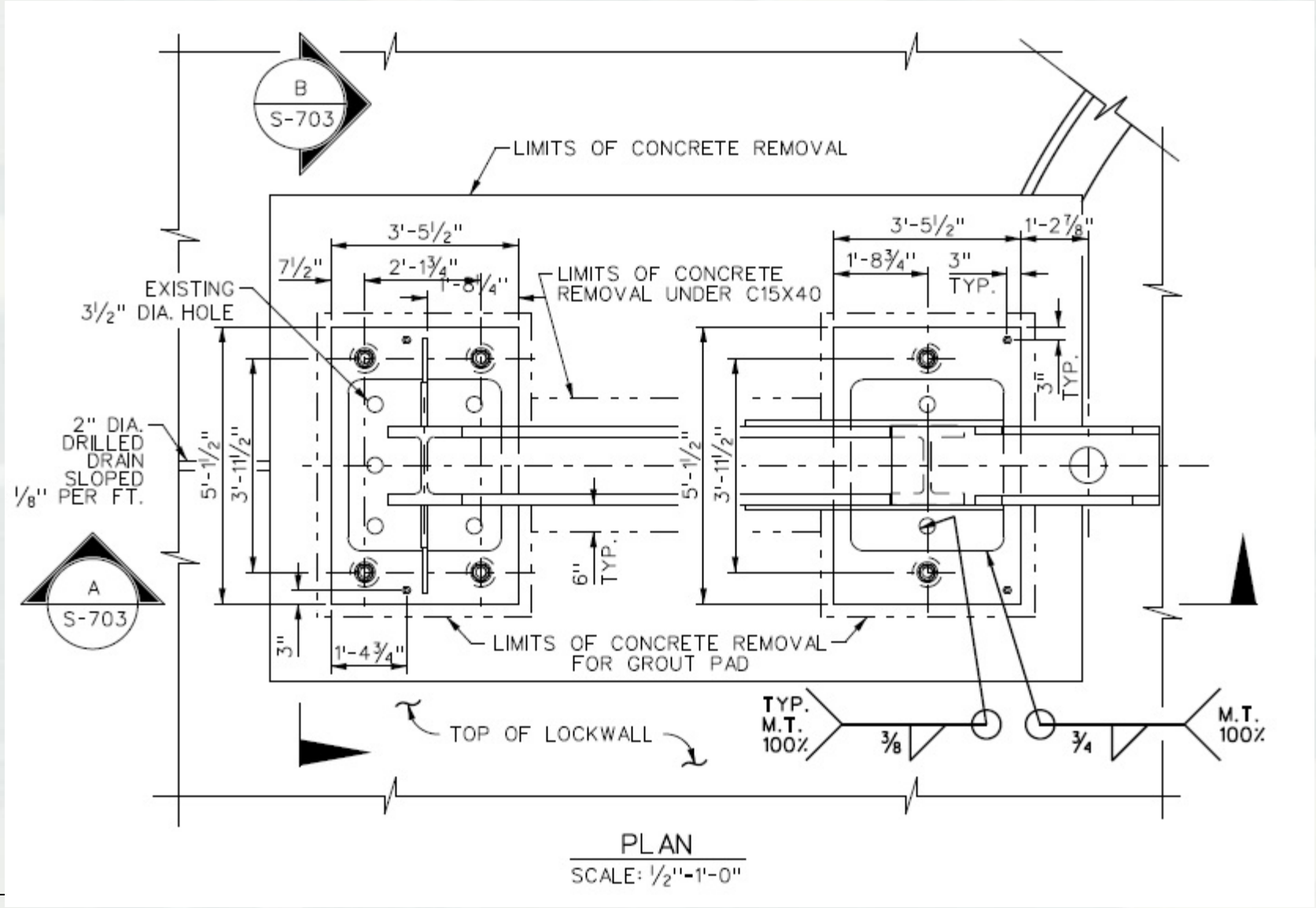
Solution

- Contract:
  - ▶ Remove concrete and embedded anchorage
  - ▶ If existing anchor bolts are good then
    - Replace the anchorage and fasten to anchor bolts with new nuts, place new grout, post-tension anchor bolts.
  - ▶ If existing anchor bolts are bad then
    - Weld expanded base on anchorage, install new anchor bolts/nuts, place new grout, post-tension anchor bolts.
  - ▶ Replace Concrete

Solution


LIMITS OF CONCRETE REMOVAL
LIMITS OF CONCRETE REMOVAL FOR GROUT PAD
1'-1"
6" TYP.
3" TYP.
3"
2" DIA. DRILLED DRAIN SLOPED 1/8" PER FT.
A
S-702
LIMITS OF CONCRETE REMOVAL UNDER C15X40
3" TYP.
3" TYP.
NEW 1" DIA. LEVELING BOLT (TYP.)
TOP OF LOCKWALL
PLAN
SCALE: 1/2"-1'-0"

Solution


B
S-703
LIMITS OF CONCRETE REMOVAL
3'-5½"
7½"
2'-1¾"
1'-8¼"
LIMITS OF CONCRETE REMOVAL UNDER C15X40
EXISTING 3½" DIA. HOLE
2" DIA. DRILLED DRAIN SLOPED ⅛" PER FT.
5'-1½"
3'-11½"
6" TYP.
3'-5½"
1'-2⅞"
1'-8¾"
3" TYP.
3" TYP.
A
S-703
3"
1'-4¾"
LIMITS OF CONCRETE REMOVAL FOR GROUT PAD
TOP OF LOCKWALL
TYP. M.T. 100%
⅜
¾
M.T. 100%
PLAN
SCALE: ½"-1'-0"

Construction

Construction

- Sep 2014 - IDIQ Contract was awarded
- Oct 2014 – On-site meeting with Contractor and his subs.

Construction

- Nov 2014 – Jan 2015 Activities:
  - Submittal/review process with Engineering and Construction including development of a schedule.
  - Existing date to start removal of concrete is 25 Feb 2015.
  - Contract completion is set for 29 Apr 2015.
  - Coordination- Two face to face meetings with nav industry reps, weekly update emails from Construction to Operations and nav industry reps.

Resullts

Results

[Check back in a few months.]

Questions?